A Botanical Survey of the Small Islands of the Three Kings Group

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ABSTRACT.

Descriptions are given of the vegetation of North-East I., South-West I., and West I. together with a table which compares their vascular floras with that of Great I. The natural climax throughout the Group is considered to have been a mixed coastal forest rich in small tree species. These were overtopped by an emergent stratum of *Metrosideros excelsa* wherever the terrain was favourable to its persistence by vegetative propagation. This forest is only preserved today on West I. The other three islands are considered to have been completely deforested by Maori settlers, and to exhibit at present stages of a sere in which *Meryta sinclairii* tends to form a persistent subclimax because of the scarcity of seed trees of the climax species.

On the basis of Cheeseman's (1888, 1891)initial discoveries, the Three Kings Islands were recognised by Cockayne (1921, p. 301) as a distinct Botanical District of New Zealand, yet they remain inadequately explored because access is difficult. The Group lies about 35 miles off the North-West extremity of the North Island and consists of one large island (Great I.), three small ones (North-East I., South-West I. and West I.), and a chain of bare or scrub-covered rocks (Princes Rocks). A map of the area has been published in this journal (Vol. 3, 1948, p. 301) together with a preliminary account of the small islands (Buddle, 1948). The description of their vegetation is amplified in this paper and their floras are compared with that of Great I., though they may not be as completely known. A few small pockets of forest isolated on steep faces have not been examined and might well repay a special effort to reach them.

No landings can be made on small islands in the open ocean without suitable boats and equipment, and without a great deal of skill, judgment and perserverance in tackling the nautical aspects of the problem. My great indebtedness to Major Magnus Johnson, from whose yacht "Rosemary" all the pioneer and most of the subsequent landings have been made, will be obvious. The assistance of Mr. Ernie Beaver, who until recently operated the fishing boat "Miss Kaikohe" from Mangonui and Whangaroa, has also been invaluable, and his generosity in twice placing this powerful launch at our disposal is gratefully recorded. Others whose help on occasions has been indispensable are Mr. Murray Green, Mr. Peter Williams, Mr. Jim Fleming and Dr. Peter Brook. Part of the cost of some of these visits has been met by a grant from the Research Fund of the University of New Zealand.

SOUTH-WEST ISLAND.

The landing place used by Cheeseman (1889) beneath the gannet rookery at the south-eastern end of the South-West I. is rarely workable. However the discovery by Mr. Beaver of a secluded boat harbour inside a perforated buttress at the opposite end of the island (Figs. 4 and 5) has made is comparatively easy of access, though a steep face of rock and scrub intervenes between this landing and the forest. No attempt has yet been made to camp ashore since there is no fresh water and the rapidity with which a confused surge can develop across the entrance to the boat harbour would make it necessary to land prepared for an indefinite stay.

South-West I. is by far the largest of the three outlying islands. The area upon it suitable for scrub or forest, though only about one-tenth of that upon Great I., is estimated to be about 70 acres. Much of this slopes gently, but even on the steep west face the forest holds a continuous cover of soil. Considering its height (690 ft.), area, and fertility,* the island has a remarkably small flora (Table II) including less than a quarter of the total species recorded from Great I. and only six of the thirteen endemic in the Three Kings Group. Only fourteen of its woody species appear capable of becoming important components of a forest or scrub community, and five of them are very rare at present.

There are two major plant communities—a coastal scrub dominated by *Myoporum laetum, Coprosma repens* and *Hymenanthera novae-zelandiae* (Fig. 12), and a low forest of puka *(Meryta sinclairii)* (Figs. 6 and 7). The puka seems scarcely less tolerant of exposure and proximity to the sea than the scrub species, and appears in the shrubberies where they have accumulated a stable layer of soil and rock fragments (Fig. 12). On the windswept summit ridge it becomes however a member of the scrub canopy rather than a tree. Of the shrubs *Coprosma repens* is usually the pioneer, forming the margin of most of the woody communities and showing particular tolerance of the guano-rich soil of sea-bird nesting grounds. The burrowing of petrels is harmful to the stability and water retaining power of the soil, and there can be no doubt that several faces immediately above the sea-cliffs which are bare, in herbage, or in scrub, are in this condition because of present or recent use as nesting grounds. At one point close

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* I am indebted to the Director of the Soil Bureau, D.S.I.R., for the following report upon a sample of litter and surface soil from within the puka forest on the southern slope.

"Lab. No. 5954 Horizon: Ao

Loss on Ignition%	60.2	Total Calcium m.e.%	116.0
Acid Insol. Ash%	30.3	„ Magnesium m.e.%	38.0
Carbon%	36.3	„ Potassium m.e.%	3.9
Nitrogen%	1.26	„ Sodium m.e.%	5.6
C/N ratio	29	„ Phosphate m.e.%	48.7
pH	6.1	„ Phosphate%	1.15
Alkalinity of Ash m.e.%	131.0		

True litters are expected to have losses on ignition of about 90% and so it must be realised that the sample in question contains considerable quantities of mineral soil. It is however, very fertile. The phosphate content is extremely high and the content of the bases, especially calcium and magnesium is also very high. The C/N ratio, while showing that the organic matter is still somewhat raw, is relatively low for such an organic soil and this fact together with the high content of bases, results in the relatively higher pH that has been found.

(Sgd.) L. C. BLAKEMORE.

Analyst: G. M. WILL, 14/5/1952."

to Cheeseman's landing gannets are beginning to nest in the margin of puka forest, but there is no clear indication that any sea bird can cause retrogressive succession once forest is established. If they cannot, it would appear that a nesting site that is too long abandoned could not be reoccupied by any bird unable to adapt itself to nesting on a forest floor.

The puka forest has no continuous under-storey or ground cover apart from its rapidly decaying litter (Fig. 10). Here and there cabbage-trees *(Cordyline kaspar)* compete rather feebly for a place in the canopy. *Paratrophis smithii, Hymenanthera novae-zelandiae* and *Macropiper excelsum var. major* may form occasional weak under-shrubs, and the floor may be dotted at intervals with *Carex elingamita* and *Asplenium lucidum.* The distribution of *Colensoa physaloides, Blechnum norfolkianum* and *Pteris comans* is restricted—they occur only near the summit of the steep western face.

Two areas of the forest are not, however, dominated by puka but by pohutukawa *(Metrosideros excelsa).* The chief of these is in the shallow valley that forms the lower part of the southern slope. There is another on the eastern face. The pohutukawa canopy is an open one, and slender puka trees form a second storey beneath it interspersed with occasional attenuated cabbage-trees or *Coprosma macrocarpa.* There is an almost continuous shrubbery of *Macropiper* beneath the puka indicating that it is less exclusive of other species in these circumstances than in pure stands.

South-West I. has no established history of extensive interference either by man or by exotic animals. No Maori artifacts have been found, and the only report of Maori occupation suggests that it was the headquarters of a single family (Buddle, 1947). At the enquiry mentioned by Cheeseman (Native Land Court, Auckland-Northern Minutes, Vol. 4, p. 295) there was reference only to bird collecting on the smaller islands. Yet the puka forest cannot be regarded as a stable climax community. Puka seedlings, though they have shown themselves on Great I. to be substantially tolerant under kanuka *(Leptospermum ericoides),* fail to establish themselves until a complete break has occurred in the puka canopy through the death of one or more trees. Usually these breaks are small (Fig. 8). The largest observed was a triangle with sides approximately 60 ft. long formed by collapse of about eight trees 20-25 feet in height. In this between two and three dozen puka saplings were beginning to make good growth (Fig. 11). In the few places on the island where seed trees of more tolerant species exist this tardy re-establishment is being prevented. Such seed trees are rare as yet since cabbage-trees have somewhat intolerant seedlings and those of pohutukawa are extremely so. But on the eastern forested face there are a few fruiting parapara *(Hiemerliodendron brunoniana)* and karaka *(Corynocarpus laevigata),* and both are obviously invading the ageing puka forest immediately about them by establishing their seedlings on its floor well in advance of those of the puka (Fig. 9). A few karaka seedlings occur near the summit of the western forested face, and a single parapara seedling was noticed in 1951 beneath the pohutukawa-puka canopy that adjoins the gannet rookery.

Though pohutukawa seedlings appear to require open ground for their establishment (Baylis, 1951) this tree seems capable of persisting as a component of a climax forest because its power of re-rooting prolongs its life indefinitely. Large trees whose main limbs have sagged to the ground and become independently rooted trunks are a familiar feature of North Auckland coastal forests, especially on steep or rocky sites. It is significant that only small examples of this occur as yet on South-West I. One near the gannet rookery had spread in two directions for a distance of 25 feet. These older pohutukawas develop a bunchy, discontinuous crown below which probably all the smaller coastal trees are capable of maturing, while at least two—*Paratrophis smithii* and *Macropiper excelsum var. major*—do not appear to thrive without such protection.

If puka forest is seral one might expect some change to have occurred since Cheeseman examined the southern face of the island in 1889. He does mention three species that are no longer there, namely *Leptospermum scoparium, Pteris comans* and *Davallia tasmani.* The two ferns are both stated to have been abundant. To this list *Leptospermum ericoides* might well be added since it is now reduced to one specimen overhanging an escarpment. There is thus evidence of a thickening of the puka canopy during the last 70 years with the elimination of tea-tree *(Leptospermum scoparium* and *L. ericoides)* and two species of ground fern. The tea-tree was evidence of earlier clearings since seedlings of both species require open ground.

NORTH-EAST ISLAND.

On North-East Island the only landing place above which the cliffs can readily be climbed is on the south-eastern extremity (Buddle, 1948, P1.27, Fig. 3) where the surge rarely permits a boat to be taken alongside. Buddle and Johnson, the first European visitors, were fortunate in being able to land here twice in 1947 since the island was to be repeatedly visited over the next eight years before another landing was made. On this occasion Dr. Brook and I were ashore for about three hours.

The area of North-East I. that is suitable for scrub or forest is approximately 20 acres, i.e. about a third of that on South-West I. But the flora is larger by six species. The 30 species common to the two islands include all that are at all plentiful on South-West I. Of the additional ones in the North-East I. list, one—*Pittosporum fairchildii* —is a local endemic and two others—*Pteridium esculentum* and *Ipomoea palmata*—appear to be of ecological significance.

Dominance of puka is less complete than it is on South-West I. There is a substantial area where puka grows alone and there are small areas where puka is sub-dominant beneath pohutukawa. But at the summit of the island on shallow petrel-burrowed soil kanuka dominates with so little competition that seedling replacements have quite recently become established (Fig. 15). Kanuka is also in places a component of the scrub (Fig. 17) which otherwise resembles that on South-West I. There are small clearings in the forest which do not show the fairly prompt colonization by puka that is a feature of the small windthrows on South-West I. They appear to have been occupied for

a substantial period by low-growing species. One is filled with bracken (Fig. 16). The remainder are a tangle of trailing plants, namely *Sicyos angulata, Ipomoea palmata, Muehlenbeckia complexa* and *Parsonsia heterophylla.* In one a few kanuka and *Pittosporum fairchildii* were becoming established.

Buddle (1948) was able to recognise man-made walls and terraces on this island, and points out that D'Entrecasteaux saw a fire upon it in 1793. It is the closest of the small islands to Great I., and it appears that a short fixed rope would make it accessible at the less exposed northern end—indeed the difficulty of unaided ascent here may well be due to a recent change in the cliff face. The imperfect preservation of the endemic flora and the dominance of puka and kanuka may accordingly be ascribed to Maori occupation. The bracken patch probably occupies ground on which it was once cultivated as a food plant, and from which it has excluded competing species for more than a century.

WEST ISLAND.

There have been two landings on West Island—the first by Major Johnson alone in January, 1950, the second by Major Johnson and myself a year later. On both occasions the time spent ashore was about five hours. The ascent appears to be practicable only by the ridge which rises from the south-eastern point. Johnson succeeded in making his way onto this from the lip of a cave on its eastern side, but only with much difficulty. It is better to approach directly from the south (Fig. 20), though for the dinghy this is complicated by the proximity of a rock that is partially submerged, so that a perfectly calm sea is necessary. The landing in 1951 was accomplished in a dense fog which made photography impossible, and was depressingly reminiscent of the circumstances primarily responsible for the wreck of the "Elingamite" upon this island about fifty years previously, with much loss of life.

Apart from a narrow strip of scrub across the north-western face, which appears to be inaccessible (Fig. 18), the only area suitable for woody vegetation faces south and probably does not exceed five acres (Fig. 20). It consists entirely of fissured and broken rock, with soil accumulated only in pockets and crevices. Despite this appearance of offering a far less favourable plant environment than North-East I. or South-West I., West I. has a flora richer in woody species and in endemics than either. Outstanding among these is *Elingamita johnsoni* (Baylis, 1951) which has been found nowhere else. West I. is also the only place, apart from Great I., where *Brachyglottis arborescens* occurs. There are in all 17 woody species contributing to the dominant or sub-dominant stratum of the forest or to the canopy of the scrub against 14 on the much larger South-West I. No naturalized species are present.

For about 150 ft. above the landing place the rock is streaked with guano and encrusted with algae. Towards the upper limits of this zone the usual sea-cliff crevice species of the Group appear, namely—*Chenopodium triandrum, Cyperus ustulatus, Deyeuxia filiformis, Disphyma australe, Poa anceps, Salicornia australis, Scirpus cernuus, Spergularia marginata.* The next 100 ft. or more is occupied

by a closed community of tall flax—*Phormium tenax.* This is largely replaced about 250 ft. above the sea by forest-scrub in which the trees branch at ground level and form low flat crowns parallel with the steep angle of the face and only 5-8 ft. above it. This forest is rich in tree-species, containing *Brachyglottis arborescens, Coprosma macrocarpa, Corynocarpus laevigata, Elingamita johnsoni, Hiemerliodendron brunoniana, Hymenanthera novae-zelandiae, Melicope ternata, Meryta sinclairii, Pittosporum fairchildii, Metrosideros excelsa, Planchonella costata* var. *austromontana, Pseudopanax lessonii* and *Olea apetela.*

Towards the top of the island (609 ft.) the pohutukawa grows taller with looser crowns, and it is in this shelter that *Paratrophis smithii* and *Macropiper excelsum var. major* principally occur.

On the more exposed ridge crests and faces *Hymenanthera-Myoporum-Coprosma repens* scrub is present.

Even when allowance is made for the enterprise shown by the Maori in establishing himself on North-East I. and, on botanical evidence, on South-West I. also, it is scarcely conceivable that an attempt was ever made to cultivate West Island or, indeed, that much demand was ever made upon it for fuel. Major Johnson informs me that on his first visit he discovered one undoubted burial cairn through which the root of a tree had grown, lifting out the skeleton, a stone axe, and a sharpening stone. His opinion that the island was reserved as the final burial place seems likely to be correct. The botanical evidence certainly suggests that West Island alone preserves a fragment of the original climax forest of the Three Kings Botanical District in an unaltered state.

DISCUSSION.

The exploitation of Great I. by Maori settlers is well established historically (Baylis, 1948). Its present covering of grass and tea-tree is obviously unnatural and is undergoing rapid change now that the island is free of the goats whose depredations followed those of man (Baylis, 1951). The smaller islands on either side of Great I. have never been over-run by browsing animals, and their intensive use by the Maori is less readily credited, nor is there the same historical foundation for it. Complete destruction of the forest of South-West I., which the present ubiquitousness of puka seems to indicate, is probably related to the abundance of fish and birds all along the adjoining Princes Rocks, and the fact that its boat harbour provides the only secure hauling-out place for canoes, apart from those on Great I. Presumably, land that was not cleared for cultivation was eventually cleared by accidental fires or for fuel, since the second growth, in so far as it was puka, would be of little use for firing.

Preservation of the original flora of the Group has been fragmentary, and as two of the local endemics—*Tecomanthe speciosa* and *Plectomirtha baylisiana*—are reduced to a single specimen, it is probable that it has been incomplete. Nevertheless, 40 species of tree or shrub have been recorded which seem capable of contributing to the canopy or second layer of a forest, or of dominating in a closed scrub community. These are indicated by an asterisk in Table II. A sufficient number of them grow close to the sea on the exposed stony face of West I. to

indicate that everywhere the climax forest was a mixed forest almost tropical in the variety of its trees and shrubs. Probably the sub-divided crowns of ancient pohutukawas that had long been spreading through the forest vegetatively often formed an emergent stratum, and the variety existed in the composition of a closer canopy of smaller trees beneath. There is nothing to support the opinion expressed in my earlier paper (Baylis, 1948) that puka was permanently dominant on the seaward margin of the forest.

The three exploited islands at present seem to provide a series of stages in the regeneration of this climax which will, of course, be greatly protracted because of the scarcity of seed trees of so many of the species. On Great Island Maori occupation was followed by the browsing of a herd of wild goats, and regeneration only began with their destruction in 1946. The chief dominants at present are kanuka and manuka *(Leptospermum ericoides* and *L. scoparium),* but their displacement by puka is under way (Baylis, 1951). The sharp separation of the *Leptospermum* and puka phases has been the consequence of long delayed establishment of puka owing to its palatability to goats. It is likely that in their absence puka can to some extent establish itself in *Leptospermum* or other shrubland that is somewhat open, in advance of the phase at which the shrubs become arborescent and senile. There is no certainty that the Maoris persisted longer upon North-East I. than they did on South-West I., but North-East I. does seem to be in a condition similar to that of South-West I. when it was described by Cheeseman 67 years ago—there is still considerable kanuka upon it. South-West I. is now at the phase of maximum dominance by puka, and its flora is so reduced that only karaka and parapara are showing any sign of displacing it.

The extent to which nesting birds, particularly burrowing petrels, can delay, halt, or reverse plant succession in the area needs to be taken into consideration. Gillham (1956) has shown in Britain that burrowed soils fluctuate more in moisture content and temperature than unburrowed soils, and become more desiccated in dry weather. The steep slopes immediately above the cliff tops on South-West I. and North-East I. seem quite clearly to be kept in an unforested state by nesting birds. Burrowing seems to be favouring persistence of kanuka on North-East I., and to be responsible for the patch of *Poa anceps* that occupies the summit of South-West I. (Buddle, 1948, Pl. 26, Fig. 3). Undoubtedly, it greatly assists in maintaining a place in the vegetation for such herbs as *Solanum nodiflorum.* But nowhere is there any indication that it can cause collapse of an established forest.

BOTANICAL COLLECTIONS.

Table I.

Date	Collector	Vessel	G. I.	SW. I.	NE. I.	W. I.
1887	T. F. Cheeseman	Stella	X			
1889	T. F. Cheeseman	Hinemoa	X		X	
Dec. 1928	W. M. Fraser	Tutanekai	X			
Feb. 1934	W. R. B. Oliver, G. T. S. Baylis, E. G. Turbott	Will Watch	X			

Date	Collector	Vessel	G. I.	SW. I.	NE. I.	W. I.
Nov. 1945	G. T. S. Baylis	Arbutus	X			
May, 1946	E. G. Turbott	New Golden Hind	X			
Jan. 1947	G. A. Buddle	Rosemary		X	X	
Dec. 1947	G. A. Buddle	„			X	
„ „	G. T. S. Baylis	„	X			
Jan. 1950	M. E. Johnson	„				X
„ „	G. T. S. Baylis	„	X	X		
Jan. 1951	G. T. S. Baylis	„				X
Jan. 1951	G. T. S. Baylis	Ocean Star	X	X		
Jan. 1952	G. T. S. Baylis	Miss Kaikohe	X	X		
Dec. 1955	G. T. S .Baylis	Rosemary			X	

VASCULAR FLORA OF THE THREE KINGS ISLANDS.

Table II.

The abbreviated dates in this table are those of first collection or of first record for the island concerned. A few records that have not been confirmed by subsequent collection have been ignored as erroneous. The collector may be identified from Table I, and herbarium references to earlier collections will be found in Oliver's (1948) paper on the Flora of the Three Kings Islands. From 1950 onwards the material has been deposited in the Otago University Herbarium. An asterisk (*) denotes a tree or shrub capable of contributing to the canopy or second layer of a forest, or of dominating in a closed scrub community.

Locally Endemic Species.

	G. I.	S-W. I.	N-E. I.	W. I.
**Alectryon grandis* Cheesem.	'89			
**Brachyglottis arborescens* Oliver	'45			'50
Carex elingamita Hamlin	'89	'50	'47	'51
**Coprosma macrocarpa* Cheesem.	'87	'89	'47	'51
**Cordyline kaspar* Oliver	'87	'87	'89	
Davallia tasmani Field	'87	'89	'55	'50
**Elingamita johnsoni* Baylis				'50
Hebe insularis (Cheesem.) Ckn.	'89	'89		
**Paratrophis smithii* Cheesem.	'87	'89	'47	'50
**Pittosporum fairchildii* Cheesem.	'87		'47	'50
**Plectomirtha baylisiana* Oliver	'45			
**Rapanea dentata* Oliver	'34			
Tecomanthe speciosa Oliver	'45			
Totals	10	4	4	6

Other Indigenous Species.

	G. I.	S-W. I.	N-E. I.	W. I.
Acaena anserinaefolia (Forst.) Druce	'89			
Acianthus fornicatus R. Br. var. *sinclairii* (Hook f.) Hatch	'87			
Adiantum affine Willd.	'87			
Adiantum hispidulum Swartz	'87			
Agropyrum kirkii Zotov	'47	'51	'55	
Angelica rosaefolia Hook	'87			
Apium prostratum Labill.	'87			
**Aristotelia serrata* (Forst.) Oliver	'89			
Arthropodium cirrhatum R. Br.	'87		'55	'51

	G. I.	S-W. I.	N-E. I.	W. I.
Arthropteris tenella J. Smith	'89			
Arundo kakaho Steud.	'87	'89		'89
Asplenium falcatum (Lam.) Copel.	'89			
Asplenium flaccidum Forst. f.	'87			
Asplenium lucidum Forst. f.		'89	'55	'51
Asplenium obtusatum Forst. f.	'87			
Astelia solandri A. Cunn.				'51
Bidens pilosa L.	'89			
Blechnum norfolkianum Christen.	'87	'52		
Blechnum procerum (Forst. f.) Labill ..	'87			
Caladenia carnea R. Br. var. *minor* (Hook f.) Hatch	'45			
Callitriche muelleri Sond.	'45			
Calystegia sepium (L.) R. Br.	'87			
Calystegia soldanella R. Br.	'51			
Calystegia tuguriorum (Forst. f.) R. Br. ..	'87			
Cardamine heterophylla (Forst. f.) Schultze	'87			
Carex breviculmis R. Br.	'87			
Carex lucida Hook f.	'45			
Carex solandri Hook f.	'89			
Carex ternaria Forst f.	'89			
Carex testacea Boott.	'87			
Carex virgata Hook f.	'87			
Centella asiatica (L.) Urban	'89			
Centipeda orbicularis Lour.	'34			
Cheilanthes sieberi Kze.	'47			
Chenopodium triandrum Forst. f.	'47	'50		'51
Cladium junceum R. Br.	'34			
Cladium teretifolium R. Br.	'87			
Cladium rubiginosum (Forst. f.) Druce ..	'45			
Clematis parviflora A. Cunn.	'87			
Clematis paniculata Gmelin	'87			
Colensoa physaloides Hook f.	'87	'52		
Collospermum hastatum (Col.) Skttsb. ..	'45			
**Coprosma australis* (A. Rich) Robn. ..	'87			
**Coprosma repens* A. Rich	'87	'50	'47	'89
**Coprosma rhamnoides* A. Cunn.	'28			
**Coprosma robusta* Raoul	'87			
**Coriaria arborea* Lindsay	'87			
**Corokia cotoneaster* Raoul	'87			
**Corynocarpus laevigata* Forst.	'89	'50	'47	'50
**Cyathea medullaris* Swartz	'87			
Cyperus ustulatus A. Rich	'89	'47	'55	'50
Cyclosorus pennigera (Forst. f) Copel ..	'34			
Danthonia semiannularis R. Br.	'89			
Daucus glochidiata (Lab.) Finsch	'89			
Deyeuxia billardieri (R. Br.) Kunth. ..	'89			
Deyeuxia crinita (L.) Zotov	'89			
Deyeuxia filiformis (Forst f.) Hook ..	'89		'47	'51
Dianella intermedia Endl.	'87			
Dichondra repens Forst.	'87		'47	
Disphyma australe (Forst. f.) Black ..	'87	'89	'47	'89
Doodia media R. Br.	'87			
Drosera auriculata Planch.	'89			
Echinopogon ovatus (Forst. f.) Beauv. ..	'87			
Eleocharis acuta R. Br.	'45			
**Entelea arborescens* R. Br.	'89			
Epilobium junceum Forst. f.	'89			
Epilobium nummularifolium A. Cunn. ..	'89			
Erechtites arguta (A. Rich.) D.C.	'89			
Erechtites quadridentata (Lab.) D.C. ..	'89			

	G. I.	S-W. I.	N-E. I.	W. I.
Gahnia gahniaeformis (Gaud.) Heller ..	'89			
**Gaultheria antipoda* Forst. f.	'89			
**Geniostoma ligustrifolium* A. Cunn. var. *major* Cheesem.	'89	'50		
Geranium dissectum L. var. *glabratum* Hook f.	'89			
Gnaphalium collinum Lab.	'87			
Gnaphalium japonicum Thunb.	'87			
Gnaphalium luteo-album L.	'89			
Haloragis erecta (Murr.) Schind	'87			
Haloragis procumbens Cheesem.	'87			
**Hedycarya arborea* Forst.	'87			
**Hiemerliodendron brunoniana* (Endl.) Skttsb.	'87	'50		'50
Hierochloe redolens R. Br.	'50			
Hydrocotyle americana L.	'87			
Hydrocotyle novae-zealandiae (Gandog.) Hill	'87			
**Hymenanthera novae-zelandiae* (A. Cunn.) Hemsl.	'87	'89	'47	'50
Hypolepis tenuifolia Bernh.	'89			
Ipomoea palmata Forst.			'47	
Juncus polyanthemus Buch.	'89			
Juncus vaginatus R. Br.	'34			
Lagenophora pumila (Forst. f.) Cheesem. ..	'87			
Lepidium oleraceum Forst. f. var. *frondosum* T. Kirk	'47	'89		
**Leptospermum ericoides A.* Rich.	'87	'89	'47	
**Leptospermum scoparium* Forst.	'87	'89[1]		
**Leucopogon fasciculatus* (Forst. f.) A. Rich	'89			
Leucopogon fraseri A. Cunn.	'87			
Lilaeopsis novae-zealandiae (Gandog.) Hill	'45			
Linum monogynum Forst. f.	'89			
***Litsaea calicaris* (A. Cunn) Hook f. ..	'87			
Lobelia anceps L.	'87		'55	
Luzula campestris D.C.	'89			
Lycopodium volubile Forst. f.	'87			
**Macropiper excelsum* (Forst. f) Miq. var. *major* Cheesem.	'87	'89	'47	'50
Mecodium sanguinolentum (Forst. f.) Presl.	'89			
**Melicope ternata* Forst.	'87	'89	'47	'50
**Melicytus ramiflorus* Forst.	'87			
**Meryta sinclairii* (Hook f.) Seem.	'46	'89	'89	'47
**Metrosideros excelsa* Gaertn.	'87	'50	'89	'47
Metrosideros perforatum (Forst.) Rich. ..	'87			
**Metrosideros robusta* A. Cunn.	'89			
Microlaena stipoides R. Br.	'47			
Microsorium diversifolium (Willd.) Copel ..	'87		'55	
Microtis unifolia (Forst. f.) Reich. ..	'87			
Muehlenbeckia australis (Forst. f.) Meissn.		'89	'47	
Muehlenbeckia complexa (A. Cunn.) Meissn.	'87	'50	'55	'51
**Myoporum laetum* Forst.	'28	'89	'47	'50
Myosotis spathulata Forst. f.	'87			
**Olea apetala* Vahl.	'34			'50
Oplismenus undulatifolius Beauv.	'87		'47	
Oxalis corniculata L.	'87			
Parietaria debilis Forst.	'87		'47	'51
Parsonsia heterophylla A. Cunn.	'45	'89	'47	
Paspalum scrobiculatum L.	'89			
Pelargonium inodorum Willd.	'89			

[1] Not subsequently recorded.

	G. I.	S-W. I.	N-E. I.	W. I.
Pellaea rotundifolia (Forst. f.) Hook ..	'89			
Peperomia urvilleana A. Rich.	'87		'55	
Phormium tenax Forst.	'87	'89	'55	'89
Phormium colensoi Raoul	'89			
Pimelea tomentosa (Forst.) Druce ..	'87			
**Planchonella costata* (D.C.) Lam var. *austro-montana* Lam.	'34		'55	'50
Plantago raoulii D.C.	'34			
Poa anceps Forst. f.	'87	'51	'55	'51
Poa seticulmis Petrie	'45			
Polystichum richardi (Hook f.) Sm. ..	'87			
**Pseudopanax lessonii* (D.C.) Goch.	'89			'50
Pteridium esculentum (Forst. f.) Ckne. ..	'87		'47	
Pteris comans Forst.	'87	'89		
Pteris tremula R. Br.	'87			
Pterostylis trullifolia Hook f.	'48			
Pyrrosia serpens (Forst. f.) Ching. ..	'87		'47	'51
Ranunculus hirtus Forst. f.	'89			
**Rapanea australis* (A. Rich.) Oliver ..	'46			
Rhagodia nutans R. Br.	'34	'89	'47	
Rubus cissoides A. Cunn.	'89			
Salicornia australis Forst. f.	'45	'89	'55	'51
Sarcochilus adversus Hook f.	'51			
Schizaea fistulosa Lab.	'45			
Schoenus foliatus (Hook f.) Blake ..	'89			
Scirpus cernuus Vahl.	'89		'55	'51
Scirpus inundatus (R. Br.) Poir	'45			
Scirpus nodosus Rottb.	'87			
Scleranthus biflorus (Forst.) Hook f. ..	'89			
Senecio lautus Forst. f.	'87	'89	'47	
Sicyos angulata L.	'87	'89	'47	'51
Siegesbeckia orientalis L.	'34			
Solanum aviculare Forst.	'89	'50	'55	'51
Solanum nodiflorum Jacq.	'45		'55	
Spergularia marginata Kittel	'87		'55	'51
Stellaria parviflora Hook f.	'89			
Tetragonia expansa Murr.	'89			
Tetragonia trigyna Hook f.	'89		'47	
Tetrapathaea tetrandra (D.C.) Cheesem. ..	'28			
Thelymitra longifolia Forst.	'87			
Tillaea sieberiana Schultz	'89			
Uncinia uncinata (L.) Kirk	'87			
Veronica plebeia R. Br.	'51			
**Vitex lucens* T. Kirk	'45			
Wahlenbergia gracilis (Forst. f.) Schrad.	'87	'47	'47	
Zoysia matrella (L.) Merrill	'45			
Totals	164	35	41	32

Naturalised Species.

	G. I.	S-W. I.	N-E. I.	W. I.
Aira caryophyllea L.	'34			
Aira praecox L.	'45			
Anagallis arvensis L.	'51			
Bromus catharticus Vahl.	'50			
Bromus mollis L.	'45			
Cerastium caespitosum Gilib.	'45			

	G. I.	S-W. I.	N-E. I.	W. I.
Chloris truncata R. Br.	'47			
Cirsium lanceolatum (L.) Hill	'45			
Cotula australis Sieb. Hook f.	'34			
Erechtites atkinsoniae F. Muell.	'51			
Erigeron canadensis L.	'50	'51		
Hypochaeris radicata Lab.	'34			
Juncus bufonius L.	'89			
Physalis peruviana L.	'47			
Phytolacca octandra L.			'55	
Polypogon monspeliensis	'47			
Solanum nigrum L.	'89	'50	'47	
Solanum nodiflorum Jacq. "var. *indicum*" ..	'55			
Sonchus oleraceus L.	'87			
Taraxacum officinale Weber	'45			
Trifolium glomeratum L.	'51			
Vulpia dertonensis (All.) Volk.	'45			
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Totals	21	2	2	0
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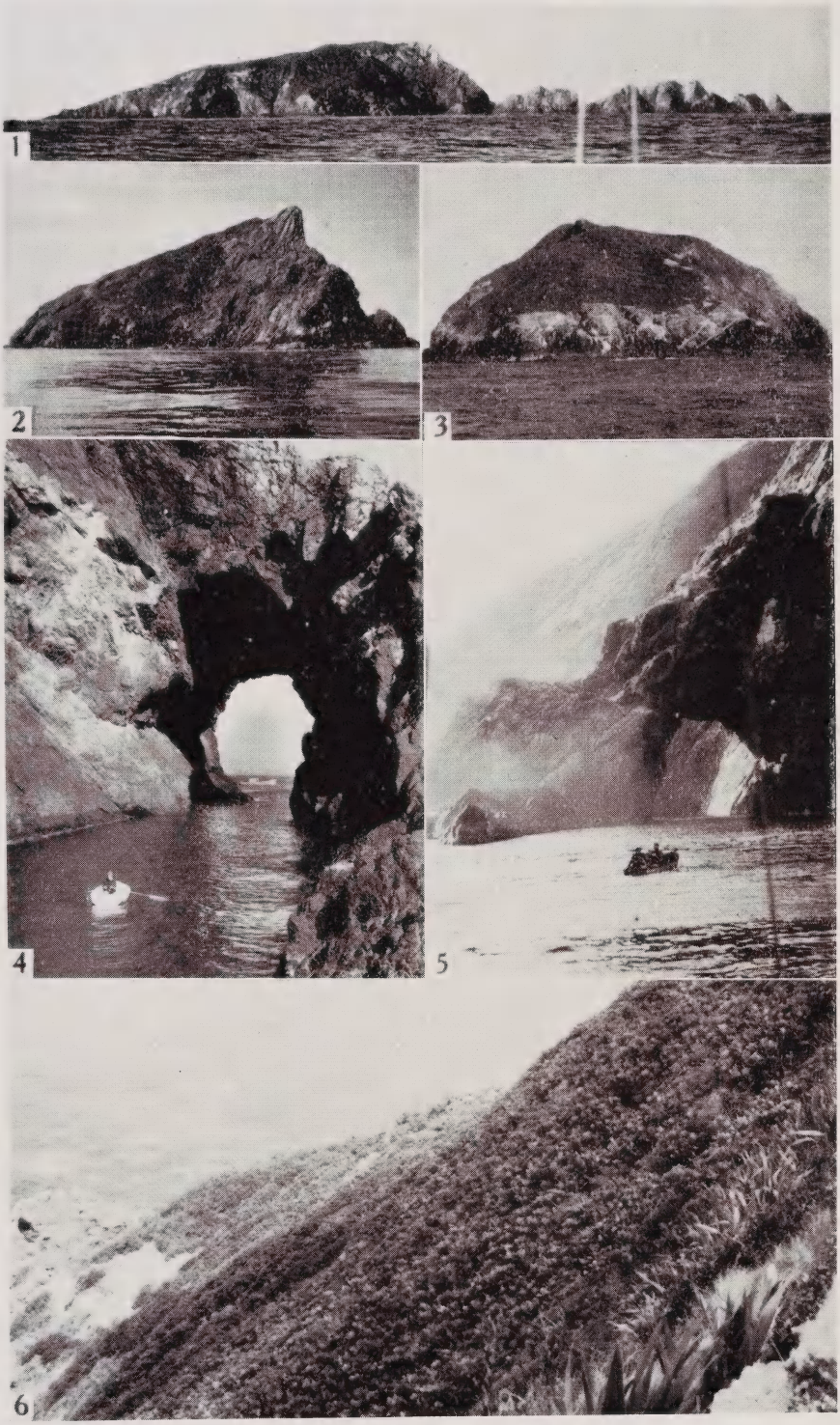

SOUTH-WEST ISLAND.

1. South-West I., Princes Rocks and West I. from the north-east.
2. and 3. South-West I. from the north and from the south-east.
4. and 5. The boat harbour from within and without.
6. Low puka forest on the western face.

SOUTH-WEST ISLAND.

7. Heavy puka forest on the north-east face.
8. Typical small clearing caused by death of puka. Temporary growth of *Solanum aviculare*. Puka seedlings in foreground.
9. A fallen puka is being replaced by a thicket of parapara which is outgrowing a puka seedling (foreground).

SOUTH-WEST ISLAND.

10. Puka forest interior. The floor is almost bare except for fallen leaves.
11. Corner of a relatively large windthrow in puka forest. Dead stems of *Solanum aviculare*, puka seedlings and bushes of *Coprosma macrocarpa*.
12. A puka tree establishing itself in ngaio-*Hymenanthera*-taupata scrub above the boat harbour.

NORTH-EAST ISLAND.

13. and 14. North-East I. from the west and from the south-east.
15. The main area of puka forest. M.-pohutukawa; L.-kanuka.
16. Small clearing in pohutukawa-puka forest occupied by bracken.

NORTH-EAST ISLAND AND WEST ISLAND.

17. North-East I. cliff-top vegetation. Mat of *Disphyma australe*, low bushes of kanuka, thicket of taupata, backed by small trees of kanuka and *Pittosporum fairchildii*.

18. and 19. West I. from the north-west and from the south-east.

20. The main area of vegetation on West I. L—landing place.